Ozark Summit 2012

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Schedule At-A-Glance

TUESDAY, June 12, 2012

1:00 pm – 2:00 pm	Registration
2:00pm – 3:30 pm	Plenary Temple 2
3:30 pm – 4:00 pm	Coffee Break
4:00 pm – 5:30 pm	Updates on Multi-Partner Projects Temple 2
5:30 pm – 6:30 pm	Social
6:30 pm – 8:00 pm	Evening Session Temple 2

WEDNESDAY, June 13, 2012

8:00 am – 9:30 am	Update on State Wildlife Action Plans Temple 2		
9:30 am – 10:00 am	Coffee Break		
10:00 am – 11:30 am	Workshop I: NRDAR Funding Temple 2	Technical Session I: Stream Sediments and Flow Temple 1	Technical Session II: Aquatic Animals Temple 3
11:30 am – 12:00 pm	Box lunch pick-up [Room] and load buses		
12:00 pm – 4:30 pm	Field Trips to Restoration Projects Wilson's Creek National Battlefield OR James River float		
4:30 pm – 5:30 pm	Return to Temple Hall or hotel Buses will shuttle attendees to Darr Center and back to hotel at the conclusion of evening		
5:30 pm – 10:00 pm	Barbecue Dinner, Evening Session, and Social Bond Learning Center at W. H. Darr Agricultural Center		

THURSDAY, June 14, 2012

8:00 am – 9:30 am	Workshop II: Conservation Easements Temple 2	Technical Session III: Terrestrial Restoration Temple 1	Technical Session IV: Stream Habitat Restoration Temple 3
9:30 am – 10:30 am	Poster Session and Coffee Break Temple 2		
10:30 am – 12:00 am	Restoration and Conservation on Private and Working Lands Temple 2		
12:00 pm – 12:30 pm	Wrap-up, adjourn		

Summit Schedule

TUESDAY, June 12, 2012

PLENARY
2:30 pm – 3:30 pm
Temple 2

Welcome Address
Tamera Jahnke, Dean, College of Natural and Applied Sciences, Missouri State University

Ozarks Terrestrial Restoration Context
Ken McCarty, Natural Resource Management Section Chief, Missouri State Parks

Ozarks Aquatic Restoration Context
Jim Petersen, Supervisory Hydrologist, USGS Arkansas Water Science Center

UPDATES ON MULTI-PARTNER PROJECTS
4:00 pm – 5:30 pm
Temple 2

Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative
John Tirpak,

Shortleaf Pine Restoration in the Interior Highlands: From Partnerships to Practice
Jane A. Fitzgerald, American Bird Conservancy

Ozark Hellbender Habitat Restoration on the Eleven Point River
Stephen O'Neal, Stream Team Biologist, Arkansas Game and Fish Commission

SOCIAL
5:30 pm – 6:30 pm
Temple 2

Substantial complimentary hors d'oeuvres will be served
Cash bar available, featuring craft beer from Mother's Brewing Company

EVENING SESSION
6:30 pm – 8:00 pm
Temple 2

Film Screening: Green Fire
"[A documentary] produced in partnership between the Aldo Leopold Foundation, the Center for Humans and Nature, and the US Forest Service. The film provocatively examines Leopold's thinking, renewing his idea of a land ethic for a population facing 21st century ecological challenges. Leopold's biographer, conservation biologist Dr. Curt Meine, serves as the film's on-screen guide."
- www.greenfiremovie.com

After Leopold's Land Ethic: Education and Experiences
Janice Schnake Greene, Professor of Biology, Missouri State University

Panel Discussion
Jane Fitzgerald, Stephen O'Neal, and John Tirpark. Led by Janice Schnake Greene.

WEDNESDAY, June, 13, 2012

Update on State Wildlife Action Plans
8:00 am – 9:30 am
Temple 2

Arkansas: Allison Fowler, Biologist/AWAP Coordinator, Arkansas Game and Fish Commission
Missouri: Dennis Figg, Wildlife Programs Supervisor, Missouri Department of Conservation
Oklahoma: Mark Howery,

Workshop and Technical Sessions
10:00 am – 11:30 am
Please see page 6 for presentations

Habitat Restoration Field Trips
11:30 am – 4:30 pm
Pick up box lunches in [Room] and depart from campus in buses
Attendees will return to Temple Hall and hotel following field trip
Bus transportation to and from Darr Agricultural Center will be provided

Evening Session
5:30 pm – 10:00 pm
Bond Learning Center at the W. H. Darr Agricultural Center

Missouri's Bats: Wind, Wings, and White-Nose Syndrome
Lynn Robbins, Professor of Biology, Missouri State University

Evening entertainment: **Da Mullets**
Springfield-based bluegrass band composed of Bo Brown, Don Cunningham, and D. R. Randolph. Bo Brown also plays with Blackberry Winter, that played the soundtrack of the Oscar-nominated movie Winter's Bone.

THURSDAY, June 14, 2012

Workshop and Technical Sessions
8:00 am – 9:30 am
Please see page 7 for presentations

Poster Session
9:30 am – 10:30 am
Temple 2
Please see page 18 for titles

Restoration and Conservation on Private and Working Lands
10:30 am – 12:00 pm
Temple 2

Funding Opportunities
Kelly Srigley Werner, USFWS Partners for Fish and Wildlife Program, Missouri State Coordinator
Bob Schroeppel, MDC Private Land Services Regional Supervisor
Montie Hawks, Area Conservationist, Natural Resources Conservation Service

Landowner Perspective
Wayne Gearhart, landowner, Eleven Point River, Arkansas
Connie Johnson, landowner, Missouri Tree Farmer

Workshop and Technical Paper Sessions

WEDNESDAY

Temple 2	WORKSHOP I: NRDAR FUNDING	
10:00 - 11:30 am	Natural Resource Damage Assessment & Restoration funding opportunities in the Springfield Plateau	Suzanne Dudding Dave Mosby John Weber Scott Hamilton

Temple 1	TECHNICAL SESSION I: STREAM SEDIMENTS AND FLOW	
10:00 - 10:20 am	Gravel sediment sources and bar distribution within the main stem of upper Bull Creek, southwest Missouri	Kyle K. Kosovich and Robert T. Pavlowsky
10:20 - 10:40 am	Classification of Arkansas flow regimes to assist environmental flows assessment for the Ozark region	Scott D. Longing and Daniel D. Magoulick
10:50 - 11:10 am	Long-term data collection in three creeks of the upper watershed of the Strawberry River, AR, Fulton Co., USA, to assess effectiveness of BMP implementation	Teresa Brueggen and Jennifer Bouldin
11:10 - 11:30 am	Geomorphic disturbance, mining contamination, and restoration implications for the Big River, southeastern Missouri	Robert T. Pavlowsky, Marc R. Owen, and Lindsay M. Olson

Temple 3	TECHNICAL SESSION II: AQUATIC ANIMALS	
10:00 - 10:20 am	Culture of native freshwater mussels for research and restoration	Chris Barnhart and Bryan Simmons
10:20 - 10:40 am	Testing the selectivity of a biocide against the invasive zebra mussel	Madeline Pletta and Chris Barnart
10:50 - 11:10 am	Distribution and abundance of the yellowcheek darter in the Little Red River drainage of Arkansas	Dustin T. Lynch and Daniel D. Magoulick
11:10 - 11:30 am	Ozark cavefish restoration in Missouri	Rick Horton

THURSDAY

Temple 2	WORKSHOP II: CONSERVATION EASEMENTS	
10:00 - 11:30 am	The use of conservation easements has grown significantly in recent decades. Conservation easements are viewed by many as a successful marriage of private property rights and public conservation benefits. This panel session will explore the reasons why landowners and land trusts use conservation easements, the logistics of entering into a conservation easement, and the tax benefits available to landowners.	Jeff Crosby
		Edward J. Heisel
		Jim Hendren
		Peggy Horner
		Doug Ladd

Temple 1	TECHNICAL SESSION III: TERRESTRIAL RESTORATION	
8:00 - 8:20 am	Landscape-based population viability models demonstrate importance of strategic conservation planning for birds	D. Todd Jones-Farrand, Thomas W. Bonnot, Frank R. Thompson, and Joshua J. Millspaugh
8:20 - 8:40 am	Population biology of restored collared lizards at Stegall Mountain Natural Area	Amy Conley and Alan Templeton
8:50 - 9:10 am	Prescribed fire effects on exotic invasive plants in Missouri's forested landscape: A literature review	Aaron P. Stevenson
9:10 - 9:30 am	The Oak Woodlands and Forests Fire Consortium	Keith W. Grabner and Michael C. Stambaugh

Temple 3	TECHNICAL SESSION IV: STREAM HABITAT RESTORATION	
8:00 - 8:20 am	River restoration to improve habitat and water quality for rare and endangered species in Arkansas	Ethan Inlander
8:20 - 8:40 am	Lessons from 45 years of habitat restoration and rehabilitation at Tumbling Creek Cave and in its recharge area	Shiloh Kirkland and Tom Aley
8:50 - 9:10 am	Water quality and forage production from municipal biosolids land application in southwest Missouri	Marc R. Owen and Robert T. Pavlowsky
9:10 - 9:30 am	The Lower Osage River Protection and Enhancement Program	Bryan Simmons, Andy Roberts, and Chris Barnhart

Paper Abstracts

Culture of native freshwater mussels for research and restoration

Chris Barnhart[1] and Bryan Simmons[2]

Freshwater mussels (family Unionidae) are among the most imperiled groups of animals in North America. At least 26 and potentially more than 40 of the 300 native North American species have become extinct in the past 100 years and many others are in danger of extinction. The largest remaining populations of several critically endangered species are found in rivers of the Ozarks, where they survive as a result of the relatively intact riverine ecosystems and good water quality in this region. Population augmentation and reintroduction to native habitats are recovery objectives for nearly all endangered mussel species. Mussel larvae are host-specific parasites of fish and are microscopically small, so that they present interesting challenges for captive culture. We have developed culture methods over the past 15 years and, in collaboration with the Kansas City Zoo, we have successfully cultured 13 species from larvae to several years of age and in some cases to sexual maturity. Presently we are producing six federally endangered species for population restoration, including Neosho mucket, pink mucket, scaleshell, winged mapleleaf, rabbitsfoot, and snuffbox. With the support of state and federal agencies we have carried out releases of propagated mussels in Missouri, Kansas, Arkansas, and Oklahoma. Propagated juvenile mussels are also being used for toxicology research, helping to fill an important data gap for determining water quality criteria. Mussels have proven to be unusually sensitive to certain pollutants, including ammonia and copper, and this information will eventually result in more stringent federal water quality standards.

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Paper and Poster

Long-term data collection in three creeks of the upper watershed of the Strawberry River, AR, Fulton Co., USA, to assess effectiveness of BMP implementation

Teresa Brueggen[1] and Jennifer Bouldin[2]

Best Management Practices (BMPs) related to agriculture are continually studied in an effort to limit potential negative impacts to natural water resources. A variety of BMPs studied are attempts to control soil erosion therefore limiting the harmful effects linked to excess sediment in waterways. These practices have been shown to be effective at preserving natural water quality. This four-year study is focused on six sites, two in each of the three subwatersheds of the upper watershed of the Strawberry River, AR. Multiple BMPs including the exclusion of cattle from waterways while providing alternative water sources and use of no-till method to plant pasture grasses are being implemented. A variety of analyses have been incorporated in this study in attempts to gauge chemical, biological and physical changes within each waterway. In this presentation, a summary of preliminary data collected from six months of intensive bi-weekly samples, two and half years of monthly samples during the implementation phase, and nine months of post-BMP samples will be summarized with a comparison between collection sites. Results from chemical testing include total suspended solids, turbidity, and nutrients including ortho-phosphates, nitrates, and nitrites. Results from biological testing include *Escherichia coli*. Annual stream bank assessment from 2010 and 2011 results will be compared. Additionally, comparisons of two fall and spring benthic macro-invertebrate analysis will be

reported. Results indicate the necessity for long term studies, with a well-established baseline, when attempting to assess changes within water ways.

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Population biology of restored collared lizards at Stegall Mountain Natural Area

Amy Conley and Alan Templeton

The combined effects of forestry and fire suppression in the early 20th century led to dramatic habitat loss for glade endemic species in the Missouri Ozarks. Attempts in the early to mid 1980s to restore several populations of the eastern collared lizard to glades on Stegall Mountain Natural Area had limited success when conservation was focused solely on glade habitat restoration. Although they were a colonizing species, after being translocated to their restored glades the lizards were incapable of dispersing through the dense, unburned understory. This resulted in loss of genetic variation and reduced population sizes with each passing year. Because this was formerly an ecosystem that was maintained by frequent fires, burning the forest as well as the glades would serve to open the woody understory and encourage herbaceous growth. Restoration of controlled burns in the mid 1990s, burns that included not only the glades, but also the forest matrix, showed dramatic results within a short period of time. Lizard population sizes flourished, lizards dispersed between the founding populations and colonized new glades, and genetic diversity increased. The project is a powerful example of the importance of restoring not just targeted habitats, but the landscape level processes that maintain those environments. The current population at Stegall Mountain is not only flourishing, but providing a valuable research tool for conservation biology and population genetics.

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The Oak Woodlands and Forests Fire Consortium

Keith W. Grabner[1] and Michael C. Stambaugh[2]

The Joint Fire Science Program has recently funded the Oak Woodlands and Forests Fire Consortium (OWFC) for implementation. The purpose of the OWFC is to promote the dissemination of fire information across a section of the interior U.S. and serve the fire information needs of natural resource managers working in oak-dominated and oak-pine communities such as woodlands, forests, savannas, and barrens. This consortium aims to promote fire information sharing and work towards establishing partnerships among fire professionals. The consortium's goals will be to enable researchers and managers to share their combined experiences studying and managing fire. Based on end-user needs assessments, the OWFC fire science delivery and outreach will utilize the web-based applications, face-to-face interactions, social media, publications, and meetings.

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Paper and Poster

Paper Abstracts

Ozark cavefish restoration in Missouri

Rick Horton

There has been a directed effort at monitoring, protecting, and conserving Ozark cavefish populations in Missouri. These efforts have been guided by "An Ozark Cavefish (*Amblyopsis rosae*) Action Plan for Missouri". A series of grants were obtained to fund habitat delineation, groundwater quality evaluation, easements, and Karst feature protection practices to accomplish Ozark cavefish conservation in Missouri. Ongoing projects involving population monitoring and genetic research continue to increase our knowledge of Ozark cavefish biology. Notable results of these efforts are: the overall number of active sites where cavefish are known has increased, specific vulnerable lands and features on the landscapes where Ozark cavefish are found have been identified and mapped, additional information on Ozark cavefish tolerance of various water quality parameters has been determined, and two new sites slightly expand the range of Ozark cavefish in Missouri. These activities as a whole work together to ensure Ozark cavefish are stable and secure throughout their range in Missouri as well as direct future efforts to conserve or restore Ozark cavefish and their habitats.

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River restoration to improve habitat and water quality for rare and endangered species in Arkansas

Ethan Inlander

The Nature Conservancy (TNC) works to design and implement streambank stabilization and stream channel restoration projects to improve habitat and water quality for rare and endangered aquatic species in priority Ozark rivers and streams. TNC generally follows the principles and practices on Natural Channel Design. This approach replicates the dimensions, pattern, and profile of stable reference reaches onto the disturbed restoration reach. The approach relies primarily on natural materials and native vegetation to stabilize unstable banks and channels. TNC leads the design, construction, and monitoring work on its projects, with assistance from partners, contractors, and volunteers. To date, TNC has implemented four relatively small projects on Ozark streams and rivers. TNC is in the planning and design phase for two larger restoration projects in coming years.

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Landscape-based population viability models demonstrate importance of strategic conservation planning for birds

D. Todd Jones-Farrand[1], Thomas W. Bonnot[2], Frank R. Thompson[3], Joshua J. Millspaugh[2]

Efforts to conserve regional biodiversity in the face of global climate change, habitat loss, and fragmentation will depend on approaches that consider population processes at multiple scales. By combining habitat and demographic modeling, landscape-based population viability models effectively relate small-scale habitat and landscape patterns to regional population viability. Here, we demonstrate their power to inform

conservation planning by using these models to evaluate responses of prairie warbler (*Dendroica discolor)* and wood thrush (*Hylocichla mustelina*) populations in the Central Hardwoods Bird Conservation Region to simulated conservation scenarios. We structured simulations to assess the effectiveness of three conservation approaches (habitat restoration, afforestation, and increased survival) as well as different placements and levels of effort for implementing those approaches. Patterns in the projected responses of the two species confirmed the potential for large-scale conservation to sustain regional populations. For example, projected abundances of prairie warblers and wood thrush tripled under afforestation and increased survival scenarios, respectively. Furthermore, responses to conservation actions were driven by interacting local and large-scale population processes (e.g., source-sink interactions and dispersal). Thus, results revealed the importance of strategically restoring habitat in the region; relying on randomly placed habitat restoration and afforestation was ineffective and potentially counterproductive to promoting prairie warbler and wood thrush viability. Other important considerations demonstrated in the results include the use of multi-faceted, ecosystem-based approaches. These models offer a valuable advance in conservation planning because they allow an understanding of the effects of local actions on regional growth, which is necessary for translating regional goals into local actions.

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Lessons from 45 years of habitat restoration and rehabilitation at Tumbling Creek Cave and in its recharge area

Shiloh Kirkland and Tom Aley

Tumbling Creek Cave, Taney County, Missouri is a designated National Natural Landmark. With 116 species identified to date, it has the most diverse cave fauna of any cave west of the Mississippi River. It provides habitat for three federally-endangered species including all known habitat for the Tumbling Creek Cavesnail. Restoration is possible only if critical resources have not been unduly degraded; if they have, then rehabilitation must be the target. Distinction between the two targets is critical in planning and implementing management strategies and actions. The Tumbling Creek Cave Foundation and Tom and Cathy Aley have purchased about 2,750 acres, including all lands overlying known portions of the cave. In karst areas the surface and subsurface are intimately connected. As a result, habitat restoration for the cave ecosystem requires land management actions and ownership control in the most critical portions of the cave's recharge area. Approaches for identifying the critical areas will be discussed. Restoration and rehabilitation efforts have included riparian corridor reforestation, re-establishment of native grasses, repair of erosion gullies, cleanups of dumps, upgrading of the sewage system for a local school, and construction of a bat-friendly gate on the cave. Many sources of funding have been used, but much of the work has been privately funded. Volunteers have been very important in some of the projects.

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Paper Abstracts

Gravel sediment sources and bar distribution within the main stem of upper Bull Creek, southwest Missouri

Kyle K. Kosovich and Robert T. Pavlowsky

Gravel mobilization and stream channel migration in Bull Creek is evident with recent flood occurrences. Landowners blame stream destabilization on a local all-terrain vehicle (ATV) area managed by Mark Twain National Forest. Bull Creek is an Ozark Plateau stream draining mostly steep topography with in-channel bedrock outcroppings and large gravel bars. It is located in Christian county, the fastest growing county in Missouri. This study will evaluate the historical patterns of reach-scale gravel bar area in a 9 km long segment of upper Bull Creek in order to understand the timing and sources of excess gravel loads to the main stem. The objectives are to: (i) use historical aerial photographs to monitor bar deposition and erosion; (ii) perform field assessments to evaluate upland, tributary and main stem sources of gravel sediment; and (iii) collect field data on channel and bar morphology to better understand the geomorphic processes involved in channel changes in response to gravel storage and transport. A channel classification system according to historical planform behavior and bedrock influence is presented. Preliminary results based on historical bar analysis indicate that: (1) bar area and meander belt widths are positively correlated; (2) bar areas at some sites do not vary much over time suggesting broader sediment source and valley-scale control of bar deposition to some degree; and (3) gravel bar area is usually highest below tributaries draining ATV use areas. The relative contribution of geomorphic forcing on gravel bar storage patterns in contrast to human influence such as ATV trail erosion will be evaluated.

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Paper and Poster

Classification of Arkansas flow regimes to assist environmental flows assessment for the Ozark region

Scott D. Longing and Daniel D. Magoulick

Providing adequate water quantity and quality in streams and rivers is a pressing issue worldwide. Establishing background environmental flows (i.e., least-affected hydrologic variability related to the frequecy, magnitude, timing, and duration of discharge) is crucial to understanding current and future freshwater conditions. Environmental flow assessments can ultimately contribute to both biodiversity conservation and freshwater supply and protection by addressing ecological structure and processes required to sustain freshwater ecosystems. Environmental flow studies were initiated in Arkansas in 2011, beginning with a hydrologic classification (using daily discharge data with a minimum 10 year period of record) across least-affected watersheds. A total of 83 reference watersheds were selected for hydrologic classification and analyses are currently underway to determine and describe classes for Arkansas's streams and rivers. Information on background environmental flows will support investigations of aquatic biodiversity patterns across flow variation gradients associated with anthropogenic disturbances, while ultimately providing information to assist the development of future environmental flow standards.

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Distribution and abundance of the yellowcheek darter in the Little Red River drainage of Arkansas

Dustin T. Lynch and Daniel D. Magoulick

The critically imperiled yellowcheek darter (*Etheostoma moorei*) is an Ozark endemic found in a geographically restricted range in the Upper Little Red River basin of north-central Arkansas. Impoundment of the Little Red River with the construction of Greers Ferry Reservoir in 1962 further reduced the range of the species, eliminating it from the main-stem Little Red River and leaving it relegated to populations in four isolated tributaries upstream of the dam with no movement between tributaries possible. Drought events in 1998-2000 further reduced the total population of the species, eliminating it entirely from one of the four tributaries and greatly reducing it in the other three. The life history of the yellowcheek darter makes it particularly vulnerable to stream drying compared to other darter species. In addition to loss of downstream refugia and isolation of remaining populations due to the dam, the species faces a suite of anthropogenic threats including gas well drilling, overgrazing, clear-cutting, and gravel-mining. For these reasons, the yellowcheek darter was listed as a federally Endangered Species in September 2011. Our study, conducted in August 2011, surveyed populations of the yellowcheek darter in the South Fork and Middle Fork of the Upper Little Red River drainage at 12 sites where the species has been known to occur using a randomly determined 1 m^2 quadrat kickseining technique in riffle habitat and taking physical characteristics of the habitat, including substrate size, flow rate and depth. Presence 4.0 software was used to determine occupancy (ψ) and probability of detection (p) in the species throughout its range at different spatial scales. Forty seven yellowcheek darters were captured, and the species was found at 7 of the 12 sites. Occupancy rate and detection probability differed greatly when examined at different spatial scales (site scale versus riffle scale). At the site scale, occupancy was 0.6861 ± 0.1806. At the riffle scale, occupancy was 0.4448 ± 0.1093. Depth, flow rate, and substrate size all appear to be important predictors of occupancy in this species. Protection of remaining habitat and habitat restoration, as well as captive propagation and reintroduction, may be crucial in the future conservation of the yellowcheek darter.

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Water quality and forage production from municipal biosolids land application in southwest Missouri

Marc R. Owen and Robert T. Pavlowsky

Biosolids are the residual by-product of the municipal treatment of wastewater used as an alternative organic fertilizer. When applied to agricultural fields at appropriate rates, biosolids can be a safe and effective part of a nutrient management plan. The City of Springfield's Southwest Wastewater Treatment Plant produces approximately 6,000 dry tons of biosolids per year providing local farmers a much needed source of nutrients and organic matter that otherwise would be sent to the landfill. Questions still remain about the impacts on water quality runoff from treated fields under local soil, slope, and crop conditions found in southwest Missouri. A multi-disciplinary team from the City of Springfield, Missouri State University, and the Natural Resources Conservation Service conducted a 3-year study to compare the runoff rates of nutrients, metals, and

bacteria from fields treated with biosolids to fields treated with traditional inorganic fertilizer. The purpose of this study was to determine the effect of biosolids application on runoff and forage quality under local field conditions. The objectives of this study are: 1) implement an experimental field plot monitoring program using runoff auto-samplers to measure the concentrations and loads of nutrients and metals released from fields treated with biosolids; 2) compare the levels of nutrients and metals in runoff and forage measured in biosolids applied fields to fields treated as control (no application) and with traditional fertilizer; and 3) use this information to support the continued approval of biosolids applications by government regulators and provide information to the general public on the safety of using biosolids as a component in an overall nutrient management plan. Results show nutrients from fields treated with commercial fertilizers are more mobile and can deliver higher amounts of nutrients to receiving waters compared to the equivalent low rate biosolids applied site with similar nutrient inputs. Forage crop analysis showed fields with biosolids treatments produced more or similar quantity, and better or similar quality of forage as the mineral fertilizer treatment. While this study shows properly applied biosolids are a safe and effective fertilizer, how biosolids application as an organic matter amendment can improve the quality, water holding capacity, and ecological functionality of soil in the Ozarks is less understood.

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Geomorphic disturbance, mining contamination, and restoration implications for the Big River, southeastern Missouri

Robert T. Pavlowsky, Marc R. Owen, and Lindsay M. Olson

Rivers systems can take decades to centuries to recover from the effects of anthropogenic disturbances. In order to support long-term restoration goals, this study evaluates the geomorphic condition and recovery trends along 180 km of Big River in the Ozark Highlands in southeastern Missouri. Presently, restoration plans are being considered for the Big River to reduce environmental exposure to lead (Pb) and to restore and protect endangered mussel beds in the Big River. Two different types of historical land disturbance have affected both channel stability and sediment quality in the Big River. First, large-scale mining operations in the Old Lead Belt released excessive amounts of Pb-contaminated tailings to the Big River from 1869 to 1972. Presently, channel and floodplain deposits are contaminated above action limits with Pb from Leadwood (R-km 171) to the confluence with the Meramec River (R-km 0). Channel contamination levels peak at >1,000 ppm Pb near mining areas in St. Francois County. Overbank floodplain deposits are contaminated with maximum concentrations >6,000 ppm Pb both within and far below mining areas. Of the total Pb contained in the 227 million Mg of tailings produced during the mining period, 23% still remains stored in tailings piles, 2% is stored in channel sediments, and 30% is stored in floodplain deposits along the mainstem. Second, European settlement phase land clearing and agriculture peaked between 1880 and 1920 in the region. During this period, up to 2 m of overbank sediment was deposited on floodplains and larger gravel bars began to form in the main stem in response to increased upland soil erosion, gully incision, and tributary sediment delivery. The geomorphic recovery process is complex in the Big River. Gravel bar area and bank erosion rates have not decreased since the 1930s. In fact, large floods and/or tributary incision may have increased geomorphic activity to high levels in recent times. Active and stalled bed waves occur in most segments and they are best

expressed in the mining area, possibly due to the greater bed mobility of the finer tailings materials. Lateral channel erosion is occurring in association with both new floodplain formation (recovery process) and channel widening (disturbance response). Implications of the geomorphic recovery process and long-term sediment contamination trends on potential restoration plans will be described. Issues to be covered include the risk of sediment aggradation on downstream river segments, sources of contaminated sediment to the channel system, and mitigation efforts to reduce sediment and contamination problems.

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Testing the selectivity of a biocide against the invasive zebra mussel

Madeline Pletta and Chris Barnhart

The zebra mussel (*Dreissena polymorpha*) and quagga mussel (*D. bugensis*) are freshwater bivalves native to Eastern Europe. Both species were introduced into the Great Lakes in the 1980s, presumably via ballast water of ships. They have subsequently spread widely into rivers and lakes, reaching large population densities at many sites. *Dreissena* are harmful invasives and have multiple ecological and economic impacts. *Dreissena* attach to hard substrates via byssus threads, and can therefore foul submerged structures and block screens, pipes, and passages carrying water. *Dreissena* also compete directly with native mussels and other suspension feeders for food. Efforts to control zebra mussels using molluscicides such as copper or potassium are complicated by undesirable effects on non-target organisms, including native mollusks, many of which are endangered. In an effort to identify a selective toxin, researchers at the New York State Museum discovered that cell wall components of a common soil bacterium, *Pseudomonas fluorescens*, kill *Dreissena* when ingested. Preparations with the trade name Zequanox are being commercialized for *Dreissena* control. We are testing effects of Zequanox on non-target bivalves, native mussels in the family Unionidae. Native mussels were propagated from larvae and cultured to a size of several mm. These juvenile mussels were exposed in static systems to five concentrations of Zequanox for 72 hours, with complete water change at 12-h intervals. Survival was then monitored for 10 days in control conditions. No mortality was observed at dosage recommended for treatment of *Dreissena* (200 mg/L). The LC_{50} (concentration lethal to half of exposed animals) for native mussels was approximately 500 mg/L. Zequanox developed high BOD within 12 hours and concentrations greater than 200 mg/L depressed dissolved oxygen and elevated ammonia. The observed effects of high concentrations on native mussels may be the result of these water quality changes rather than direct toxicity.

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Paper and Poster

Paper Abstracts

The Lower Osage River Protection and Enhancement Program

Bryan Simmons[1], Andy Roberts[2], and Chris Barnhart[3]

Bagnell Dam was built by the Union Electric Company (now Ameren Missouri) and was completed in 1931. The dam impounds 180 miles of the mainstem Osage River and its major tributaries, including the lower reaches of the Niangua, Pomme de Terre, and Sac rivers. Operation of the dam provides economic benefits including hydropower and recreational opportunities, but at the cost of significant and ongoing impacts on

fisheries, native ecosystems, and endangered species. In 2004, Ameren Missouri applied for federal relicensing, and in 2005 filed a settlement agreement with the Federal Energy Regulatory Commission (FERC) on behalf of itself and several agencies including the U.S. Fish and Wildlife Service, National Park Service, Missouri Department of Conservation, and Missouri Department of Natural Resources. As part of the relicensing agreement, the Lower Osage River Protection and Enhancement Program (LORPEP) was established. This agreement was written into the new project license issued by FERC in 2007. New license articles specify major environmental enhancements for the lower Osage River including improved minimum flows, dissolved oxygen, flow ramp-down rates, and fish protection measures at the dam. The articles also established funding for sport fish propagation, endangered mussel species propagation and monitoring, and erosion control and habitat restoration to occur within the 80 miles below Bagnell Dam (Lake of the Ozarks). The LORPEP is currently being implemented, providing adaptive management actions to improve aquatic habitat, protect and enhance aquatic resources, and reduce adverse effects of project operation, including impacts on the federally endangered pink mucket (*Lampsilis abrupta*) and scaleshell (*Leptodea leptodon*) pearly mussels in the lower Osage River.

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Paper and Poster

Prescribed fire effects on exotic invasive plants in Missouri's forested landscape: A literature review

Aaron P. Stevenson

The impact of exotic invasive species on terrestrial natural communities is well documented. In Missouri, more than 200 exotic plants have invaded upland and lowland habitats across the state. Prescribed fire is a restoration tool used across many Ozark habitats, but its effects on exotic plants are largely unknown or the information available is inconclusive. This paper outlines the impacts of fire for thirteen exotic plant species found in Missouri's forested landscapes: Amur bush honeysuckle (*Lonicera maackii)*, autumn olive (*Elaeagnus umbellata*), border privet (*Ligustrum obtusifolium*), common buckthorn (*Rhamnus cathartica*), garlic mustard (*Alliaira petiolata*), Japanese honeysuckle (*Lonicera japonica)*, Japanese stiltgrass (*Microstegium vimineum*), Morrow's bush honeysuckle (*Lonicera morrow*), multiflora rose (*Rosa multiflora*), oriental bittersweet (*Celastrus orbiculatus*), princesstree (*Paulownia tomentosa*), sericea lespedeza (*Lespedeza cuneata)*, and tree-of-heaven

(*Ailanthus altissima*). A review of the literature reveals many conflicting reports about how prescribed fire impacts these thirteen exotic species, although there are some commonalities for a few species. Fire promoted or had no effect on four species, while fire had some success controlling the other nine exotic plant species. Coupling fire with other management strategies (e.g., herbicide) offered the best success at controlling select exotic species.

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Posters

Culture of native freshwater mussels for research and restoration
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Aquatic vegetation monitoring at Ozark National Scenic Riverways, Missouri, 2007-2011
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Non-point pollution sources and transport in rural Spring Creek, SW Missouri
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Regime models as tools for stream restoration in the James River, southwest Missouri Ozarks
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Springs as thermal refugia: movement and habitat use patterns of an indicator species
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The Oak Woodlands and Forests Fire Consortium
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Green Leadership Academy for Diverse Ecosystems (GLADE): A restoration education and action project
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In-channel flow trends in Missouri using historical records and contemporary streamflow models
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Geologic influence on aquatic invertebrate community structure and integrity in Ozark tributaries at Buffalo National River and Ozark National Scenic Riverways
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Urban water quality in the Springfield, Missouri area: MS4 monitoring results
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Using land-cover change as a dynamic variable in hydrologic landscape models
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Gravel sediment sources and bar distribution within the main stem of upper Bull Creek, southwest Missouri
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Observations of flight and response to microhabitat drying of *Heterosternuta sulphuria* and *H. phoebeae* (Coleoptera: Dytiscidae), two endemic species of concern in Ozark streams
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Ozarks erosion vulnerability maps for decision support and landscape planning
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Urban water quality restoration in the metropolitan Springfield area, SW Missouri
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Historical mine tailings inputs and their long-term effects on channel morphology and substrate, Big River, southeast Missouri
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Channel stabilization and riparian corridor enhancement in an urban stream, Springfield, Missouri
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Testing the selectivity of a biocide against the invasive zebra mussel
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Effects of nutrients and large consumers on stream ecosystem structure
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Coastal fishery restoration through implementation of a new national sanctuary program: Baseline fish and habitat surveys in Bluefields Bay, Jamaica
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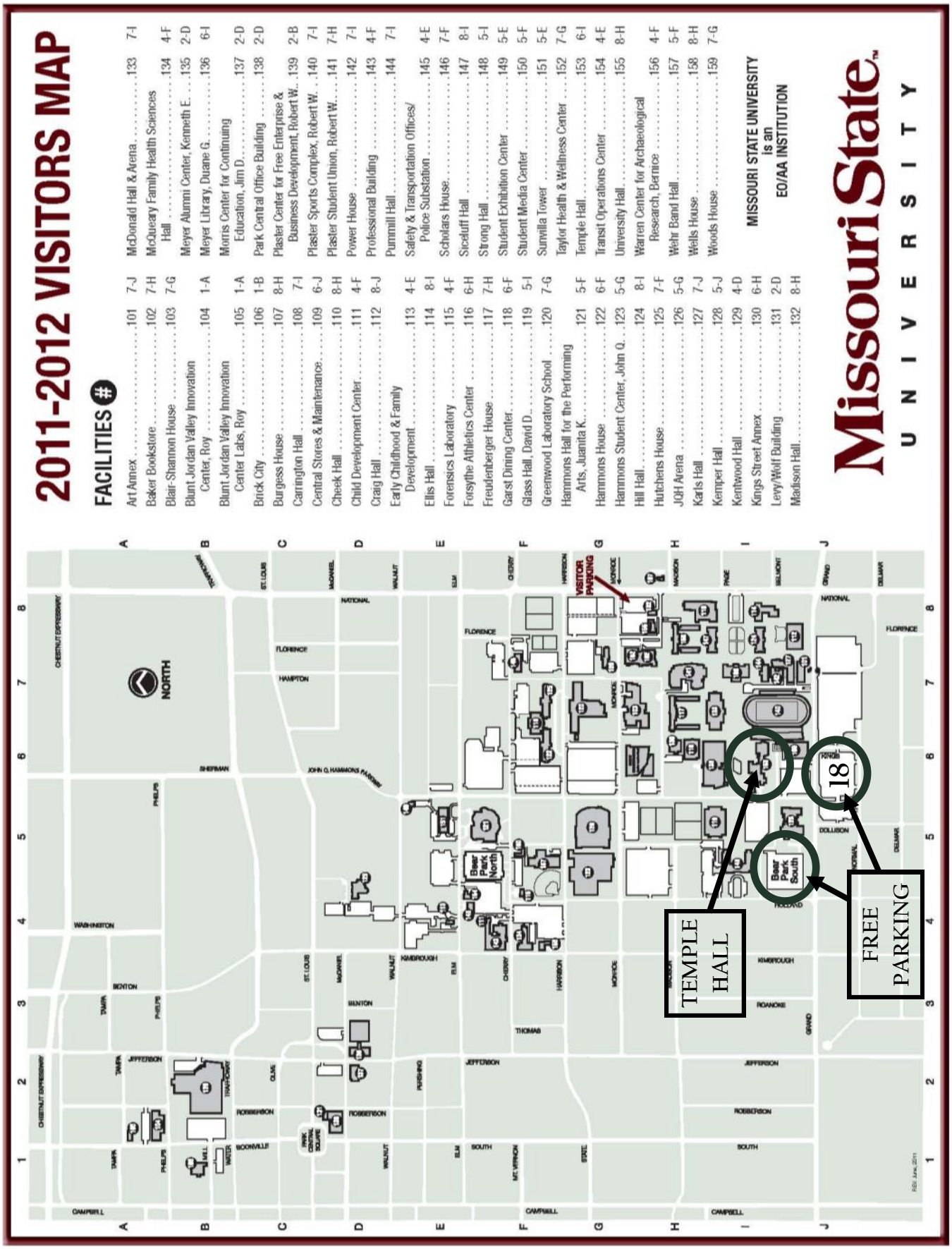
Campus Map


2011-2012 VISITORS MAP
FACILITIES #
Art Annex 101 7-J
Baker Bookstore 102 7-H
Blair-Shannon House 103 7-G
Blunt Jordan Valley Innovation Center, Roy 104 1-A
Blunt Jordan Valley Innovation Center Labs, Roy 105 1-A
Brick City 106 1-B
Burgess House 107 8-H
Carrington Hall 108 7-I
Central Stores & Maintenance 109 6-J
Cheek Hall 110 8-H
Child Development Center 111 4-F
Craig Hall 112 8-J
Early Childhood & Family Development 113 4-E
Ellis Hall 114 8-I
Forensics Laboratory 115 4-F
Forsythe Athletics Center 116 6-H
Freudenberger House 117 7-H
Garst Dining Center 118 6-F
Glass Hall, David D. 119 5-I
Greenwood Laboratory School 120 7-G
Hammons Hall for the Performing Arts, Juanita K. 121 5-F
Hammons House 122 6-F
Hammons Student Center, John Q. 123 5-G
Hill Hall 124 8-I
Hutchens House 125 7-F
JQH Arena 126 5-G
Karls Hall 127 7-J
Kemper Hall 128 5-J
Kentwood Hall 129 4-D
Kings Street Annex 130 6-H
Levy/Wolf Building 131 2-D
Madison Hall 132 8-H
McDonald Hall & Arena 133 7-I
McQueary Family Health Sciences Hall 134 4-F
Meyer Alumni Center, Kenneth E. 135 2-D
Meyer Library, Duane G. 136 6-I
Morris Center for Continuing Education, Jim D. 137 2-D
Park Central Office Building 138 2-D
Plaster Center for Free Enterprise & Business Development, Robert W. 139 2-B
Plaster Sports Complex, Robert W. 140 7-I
Plaster Student Union, Robert W. 141 7-H
Power House 142 7-I
Professional Building 143 4-F
Pummill Hall 144 7-I
Safety & Transportation Offices/ Police Substation 145 4-E
Scholars House 146 7-F
Siceluff Hall 147 8-I
Strong Hall 148 5-I
Student Exhibition Center 149 5-E
Student Media Center 150 5-F
Sunvilla Tower 151 5-E
Taylor Health & Wellness Center 152 7-G
Temple Hall 153 6-I
Transit Operations Center 154 4-E
University Hall 155 8-H
Warren Center for Archaeological Research, Bernice 156 4-F
Wehr Band Hall 157 5-F
Wells House 158 8-H
Woods House 159 7-G
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UNIVERSITY
NORTH
VISITOR PARKING
Bear Park North
Bear Park South
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TEMPLE HALL
FREE PARKING

Temple Hall Floor Plan

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